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Research Article

Psychometric Properties of Turkish Version of Pediatric Daytime Sleepiness Scale (PDSS-T)

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SUMMARY

Purpose: The aim of the research was to evaluate the psychometric properties of the Pediatric Daytime Sleepiness Scale-Turkish Version (PDSS-T).
Methods: The researchers chose a study sample of 522 grade 5–11 students. Data were collected using a demographic data collection form and the PDSS-T.
Results: Cronbach α for the scale was .79 and Kaiser-Meyer-Olkin coefficient was .78. Item-total correlations for the scale varied between .53 and .73 ($p < .001$). The indices of model fit were determined to be the root mean square error of approximation at .07, the goodness of fit index at .97, and the comparative fit index at .97.
Conclusions: The study's results showed that PDSS-T is a valid and reliable instrument for detecting Turkish-speaking children's and adolescents' daytime sleepiness. PDSS-T is convenient for professionals to prevent and manage daytime sleepiness.

Introduction

In addition to being in a state of reversible unconsciousness, sleep is a state of immobility during which the body rests and is also in an active renewal process that reprepares the whole body for life [1]. Sleep is a universal concept, and children pass 40.0% of the day in sleep [2]. Research conducted so far indicate that children and adolescents need to sleep more than 8 hours a day [3]. When night sleep drops below 8 hours, wakefulness deteriorates which contributes to poorer school performance. A short night's sleep affects negatively the developmental levels of children and adolescents, and reduces their quality of life. Despite the increasing need for sleep, daily sleep duration often shortens and the child may experience many problems [4]. Adolescents preparing for school often sleep late and wake up early. This pattern may lead to chronic sleep problems, which then results in daytime sleepiness that may lead to learning and attention problems [2]. In the adolescent period, the adolescents spend more time at the computer and other devices. The excessive devices using gives rise to late sleep time, delay the circadian rhythm, suppresses melatonin levels, increases alertness and decrease sleep duration [5,6]. Insufficient sleep due to increasing academic activities and social activities and the tendency to sleep late and wake up early may affect the daytime sleepiness state of the adolescent period [7].

Wolfson and Carskadon [8] show that the students with low levels of achievement are relatively sleep deprived, in comparison to successful students. These students' bedtime is later, and the students have irregular sleep patterns. When Mercer et al [3] questioned the beliefs of children regarding their sleep sufficiency, the researchers reported that 46.0% of the children believed that homework caused daytime sleepiness while 54.0% of the sample stated that they felt sleepy all day. While there are many studies on daytime sleepiness in foreign countries [8–18], no study examining daytime sleepiness exists in Turkey. Most of the studies examining sleep relate to sleep factors and sleep hygiene [17–20]. Sleep hygiene is a variety of different practices that are necessary to have normal, quality nighttime sleep and full daytime alertness

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[21]. However, it is of paramount importance to define the level of daytime sleepiness that can affect both academic and cognitive functions. Nurses, especially school nurses have an important role in determining daytime sleepiness and related problems. Nurses can determine daytime sleepiness status more than other professionals do because they are constantly with children and observe their problems more closely. However, nurses need tools that can be used easily to determine and prevent daytime sleepiness [19,20]. Furthermore, there is no reliable and valid Turkish measurement tool that examines daytime sleepiness status of children and adolescents. Standard scales are needed to identify daytime sleepiness of children, to determine factors affecting it and to plan necessary interventions to eliminate these factors. Due to this deficiency in the field, this study was designed to test the reliability and validity of the Pediatric Daytime Sleepiness Scale (PDSS), which is a tool that measures daytime sleepiness status of children and adolescents.

Methods

Design

An explanatory and cross-sectional descriptive design was used in this study. The study was conducted for the purpose of testing psychometric properties of the Turkish version of PDSS (PDSS-T). The secondary aim of the study was to determine factors that affected pediatric daytime sleepiness. The research was carried out in secondary and high schools under the Ministry of National Education in a city in the western region of Turkey during the months of February and March 2014.

Setting and samples

In the instrument testing, experts recommend including 5–10 people for every item on the instrument. Additionally, at least five people per item are necessary to perform a factor analysis. Ten people per item are needed to achieve parametric sampling [22–25]. Taking studies such as one by Drake et al [9] as an example of this design, the sample size needed was at least 84 for Type II error to be at .010 and Type I error to be at .010. However, for factor analysis, a sample size of least 100 is required to discriminate relationships between the variables [9].

To test the reliability and validity of the PDSS that consists of 8 items, 10 children or adolescents were selected for each item. Thus, the study sample consisted of 80 children and adolescents according to our calculations. After considering the study of Drake et al [9], we calculated that the study sample should consist of 84 children and adolescents. The literature reported that a sample of up to 100 entities is poor, up to 200 entities fair, up to 300 entities good, up to 500 entities very good, and up to 1,000 entities excellent in factor analysis [22–27,31–32]. Professionals urged researchers to obtain samples of 500 or more observations whenever possible [22–32]. To be able to determine the relationships between the variables of the scale more clearly and generalize the results of the scale, all students in the selected schools were included in the study. The inclusion criteria of the study were that students were in grade 5–11, agreed to participate voluntarily, provided a signed consent form from the parents, and could read and understand the material they were given. The sample comprised 543 students originally, and 522 grade 5–11 students agreed to take part in the study. Only students whose parents gave their written consent were included in the study. The response rate was 96.1%.

Ethical consideration

This study was approved by the Institutional Review Board of the University (IRB approval no.: 1268-GOA-2013/47-19). Permission was also obtained from the Izmir Provincial Directorate for National Education to conduct the study. Written consent from parents and verbal consent from children were received to enable the children to participate in the study.

Instruments

In the study, the Questionnaire Form and the Turkish version of PDSS-T were used to collect data. The Questionnaire Form and PDSS-T were given in each class for the duration of a lesson. Before completing the scales, the researchers explained the forms. Students were asked not to write any information about their identities on the forms, so that their identity was confidential. Completed forms were collected by the researchers.

The Questionnaire Form, developed by the researchers, includes 18 questions about age, gender, grade, school, perceived academic achievement, smoking, sleep patterns and bedtime status. Early bedtime status was defined as sleep before 10 p.m.

The original PDSS was developed in 2003 by Drake et al as an 8-item scale for the purpose of evaluating daytime sleepiness in children and adolescents [9]. The items are scored on a 4-point Likert-type scale. The point distribution for the PDSS is 0–32. The highest score of PDSS indicated more daytime sleepiness. In the original study, the Cronbach α was .80. In this study, PDSS-T showed good internal consistency, with Cronbach α at .80 and .81 for the split-half samples [9].

Data collection/procedure

Translation of PDSS

Adaptation means adapting item by culture [22–25]. In this study, permission was received by e-mail from Christopher Drake to adapt the PDSS to Turkish and to use it. PDSS was translated into Turkish by three independent bilingual language experts. After it was translated into Turkish, the translated version of PDSS was reviewed by the research team. Then, the revised version was checked by a Turkish language expert. A different language expert back-translated PDSS-T [22–25].

Content validity of PDSS

Researchers recommend that at least three experts give their opinion to determine that the translation form is equivalent to the original form and calculate the content validity index (CVI) [22–25]. In this study, the four experts were given the original PDSS and PDSS-T together. They were asked to assess the convenience of the PDSS items on a scale of 1–4 (1 = *not appropriate at all*, 4 = *completely appropriate*). CVI was calculated by dividing the number of experts who had a rating of either 3 or 4 by the total number of experts [22–25]. Based on their responses, the scale level CVI (S-CVI) and item level CVI (I-CVI) were calculated. If the S-CVI and I-CVI were more than .80, then it was interpreted as indicative of a high content validity [22–25].

Reliability of PDSS

Cronbach α, split-half method, item-total correlation, floor and ceiling effects were used for reliability analysis. Experts specify that the acceptable and minimum value is .70 for Cronbach α, Spearman-Brown and Guttman split-half values. It is recommended that item-total correlation coefficient be greater than .20 or .25 for an item to be acceptable. Floor or ceiling effects are

considered present if more than 15.0% of respondents achieved the lowest or the highest possible score, respectively [22–25].

Validity of PDSS

Validity was examined through concordance validity, construct validity and contrasted group comparison. Concordance validity was evaluated by I-CVI and S-CVI. Construct validity was examined through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Contrasted group comparison was used for validity analysis. The model verification of the comparative fit index (CFI) was conducted by Chi-square test, degree of freedom, root mean square error of approximation (RMSEA), goodness of fit index (GFI), CFI, and normal fit index (NFI).

Pilot study

After the translation of the PDSS, the next step was to administer it to a 10–20 person sample who had similar characteristics to those who would be administered the scale in the research. These participants were not included in the study. It is taken feedback about items. If it has suggested about the items, the items correct to according the feedbacks. The scale was then developed into its final format. This procedure should be done with each translation [22–25].

The scale was administered to 30 adolescents. Because no negative feedback was received, the internal validity and reliability of the PDSS-T were judged to be enough for administration to the study sample.

Data collection

The study data were collected by researchers between February 1st and March 15th, 2014 through distributing forms to students in the classroom. Students who volunteered had permissions from both the Ministry of National Education and their parents. Students could read and write at the level required to complete the questionnaires. Before filling the forms, the researchers explained the demographic form and the PDSS-T. Students were asked not to write any information about their identities to ensure their confidentiality. Completed forms were collected by researchers.

Data analysis

Data were analyzed using the CVI, EFA, CFA, Pearson's correlation analysis, means and standard deviations, and floor and ceiling effects. Multiple regression analysis was used to identify factors that affect daytime sleepiness. Test for multicollinearity was performed for regression. Variance Inflation Factor (VIF) and Tolerance were used to detect multicollinearity between the independent variables of regression model. Independent variables removed from the model by VIF is higher than 10 and tolerance is less than .20. The significance level was accepted as $p < .05$.

Results

The average age of participants in this study was 14.04 ± 1.82, and 50.6% of them were female. Of the students who participated in the study, 13.7% were fifth graders, 13.0% sixth graders, 10.5% seventh graders, 10.5% eighth graders, 30.1% ninth graders, 19.5% tenth graders and 2.7% eleventh graders.

Validity of PDSS-T

Concordance validity of PDSS-T

The four experts' scores were analyzed by I-CVI and S-CVI. I-CVI was determined to be .96–1.00. S-CVI was determined to be .99 between experts. Thus, the experts' scores were in accordance.

Construct validity of PDSS-T

According to EFA, the Kaiser-Meyer-Olkin was determined to be .78; the Bartlett's test was significant ($\chi^2 = 1{,}110.74$, $p < .001$). Only one factor was extracted. The exploratory factor loading was .54–.72. The total explained variance was 41.% (Table 1).

The confirmatory factor loading was .39–.65. The indices of model fit were determined as follows, RMSEA at .07, GFI at .97, CFI at .97, NFI at .96, non-normed fit index (NNFI) at .95 and incremental fit index (IFI) at .97 (Figure 1).

Contrasted group comparison

The PDSS-T mean score of the students who had early bedtime was 24.95 ± 6.29 and students who reported late bedtime was 28.98 ± 6.14. There were statistically significant differences between the scale's mean scores for students who had early bedtimes and those who had late bedtimes ($t = 6.71$, $p < .001$).

Reliability of PDSS-T

The scale mean score was 27.83 ± 6.44, the floor and ceiling effects were 0.2% and 1.9%, respectively. The reliability coefficients α for the PDSS-T was .79. The split-half reliability was .71 for the first half of the scale and .71 for the second half of the scale. The correlation coefficient between the first and second halves was .52 ($p < .050$).

Item-total correlations were determined to be .53–.73 at a statistically significant level ($p < .001$; Table 2).

Factors which affected pediatric daytime sleepiness

The result of the multiple regression analysis indicated that the independent variables in the study were significantly and highly correlated with the PDSS-T of the students ($R = .60$) ($F = 18.03$, $p < .001$). These variables explain 36.2% of the daytime sleepiness status of the students. Total sleep time ($p < .001$), age ($p = .018$), excessive drinking of tea or coffee ($p < .001$), eating something before bed ($p < .001$), sleep initiation problem ($p < .001$), school achievement ($p < .001$), computer use ($p = .005$) and smoking ($p = .013$) among the independent variables were significantly associated with daytime sleepiness status, respectively. Other independent variables did not significantly predict daytime sleepiness status ($p > .050$) (Table 3).

Table 1 *Factor Loadings for One Extracted Factor after Varimax Rotation (N = 522).*

Items	Factor loadings	Explained variance %	Eigenvalue
1. How often do you fall asleep or get drowsy during class periods?	.69	41.1	3.29
2. How often do you get sleepy or drowsy while doing your homework?	.68		
3. Are you usually alert most of the day?	.54		
4. How often are you ever tired and grumpy during the day?	.63		
5. How often do you have trouble getting out of bed in the morning?	.65		
6. How often do you fall back to sleep after being awakened in the morning?	.72		
7. How often do you need someone to awaken you in the morning?	.56		
8. How often do you think that you need more sleep?	.65		

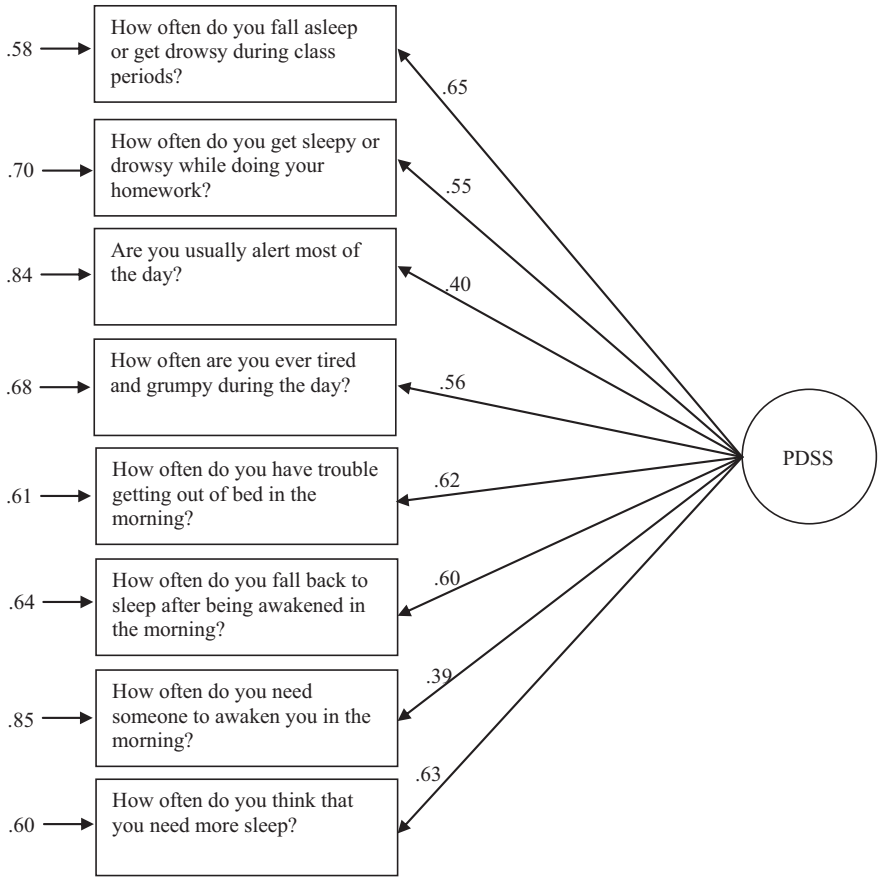

Figure 1. Confirmatory factor analysis of the Turkish Pediatric Daytime Sleepiness Scale (PDSS-T). *Note.* CFI = comparative fit index; GFI = goodness of fit index; IFI = incremental fit index; NFI = normal fit index; NNFI = non-normal fit index; RMSEA = root mean square error of approximation.

Discussion

To determine its content validity, the PDSS-T was examined by experts and reviewed, and prepared according to their suggestions [22–25]. It is possible to use a form that would enable the experts to evaluate the coherence of items through giving points. The consensus of the majority of experts may be accepted as an indicator of the content validity [26,27]. If the consensus of experts were more than .80, then it was interpreted as indicative of a high content validity [22–27]. In this study, I-CVI and S-CVI values were more than .80. According to the analysis, the expert scores were observed to be coherent. Thus, the items in the PDSS-T are deemed appropriate for Turkish culture.

In the original PDSS, eight items were grouped under one factor [9]. The result of factor analysis, the Kaiser-Meyer-Olkin was above .60, and Bartlett test was significant ($p < .001$). These values showed

Table 2 *Item-total Correlation of Pediatric Daytime Sleepiness Scale.*

Items	Item-total correlation	
	r	*p*
1. How often do you fall asleep or get drowsy during class periods?	.65	< .001
2. How often do you get sleepy or drowsy while doing your homework?	.65	< .001
3. Are you usually alert most of the day?	.53	< .001
4. How often are you ever tired and grumpy during the day?	.62	< .001
5. How often do you have trouble getting out of bed in the morning?	.67	< .001
6. How often do you fall back to sleep after being awakened in the morning?	.73	< .001
7. How often do you need someone to awaken you in the morning?	.60	< .001
8. How often do you think that you need more sleep?	.66	< .001

Table 3 *Multiple Regression Analysis of Factors Affecting Pediatric Daytime Sleepiness.*

Variables	*B*	Standard error	Standardized β	*t*	*p*
Constant	41.69	2.99		13.92	< .001
Sleep time	4.70	0.76	.23	6.16	< .001
Age	0.71	0.30	.20	2.37	.018
Excessively drinking tea or coffee	2.41	0.55	.16	4.33	< .001
Eating something before bed	1.89	0.48	.15	3.92	< .001
Sleep initiation problem	2.27	0.56	.15	4.05	< .001
School achievement	1.63	0.42	.15	3.82	< .001
Computer use	0.98	0.35	.10	2.82	.005
Smoking	2.47	0.98	.09	2.50	.013
Gender	0.02	0.50	.00	0.05	.957
Grade	0.11	0.29	.03	0.39	.695
Economic status	0.63	0.47	.05	1.34	.181
Using sleep medicine	1.37	1.42	.03	0.96	.336
Having his/her own room	0.15	0.24	.02	0.65	.514
Late night sleep	0.22	0.50	.01	0.45	.653
Drinking something before bed (e.g., tea or coffee)	0.26	0.54	.02	0.49	.621

Note. $R = .60$, $R^2 = .36$, $F = 18.03$, $p \leq .001$, Durbin-Watson (DW) = 1.954 (1.5–2.5).

that the number of samples was convenient for factor analysis [22–25].

The total explained variance was 41.1%. The result of this study has been found compatible with the results from Drake et al [9], and Yang, Huang and Song [10]. In the literature, the explained variance that was between 40.0% and 60.0% was accepted as sufficient [22–25]. Therefore, the obtained total variance of PDSS-T was at an acceptable level. The results of the analysis showed that the PDSS-T had acceptable construct validity.

According to the EFA, only one factor was extracted, and the factor loading was above the set point of .40 for all items [27]. Therefore, we did not exclude any item from the original scale. These findings are consistent with those of the original study [9], the Korean version [15] and the Portuguese version of PDSS [16]. According to our findings, PDSS-T had adequate construct validity for the Turkish population.

CFA is used to show the relationship between the scale and their items. It is recommended that CFA be used to test the scales that developed in different cultures. The literature indicates that the model's goodness of fit values, GFI, NFI, NNFI and CFI greater than .90 and RMSEA less than .08 are desirable [22–25,28]. These study results show that the CFI, GFI, NFI and NNFI were higher than .90 and RMSEA was less than .08. Fit indices in this study were not compared with those from the original study or other studies [15,16] because these results were not given in the Drake et al study [9] or in studies from other countries [15,16]. Values from this study show that the data are consistent with the model, confirm the one-factor structure, and the items sufficiently correlated with the factor. These results indicated that PDSS-T is a valid scale, and it is a reliable scale for use in children and adolescents in Turkey.

In the contrasted group comparison, researchers choose participants or groups whose scores will differ significantly [22–25,28–30]. In the current research, the PDSS-T mean scores of children who had early bedtimes and late bedtimes were compared. The research findings showed that children who had late bedtimes had higher PDSS-T scores than those with early bedtimes. The PDSS-T was able to divide significantly the two groups of PDSS-T score. This result shows that the PDSS-T is a successful scale for detecting daytime sleepiness.

Floor effects were calculated as the percentage of participants who achieved the minimum possible scores and ceiling effects were calculated as the percentage of participants who achieved maximum possible scores [31]. The floor or ceiling effects are considered present if more than 15.0% of respondents achieved the lowest or the highest possible score, respectively. If the floor or ceiling effects are present, it is likely that extreme items are missing in the lower or upper end of the scale, indicating limited content validity. As a consequence, participants with the lowest or the highest possible score cannot be distinguished from each other. Thus, reliability is reduced [31]. In this study, the floor and ceiling effects were lower than 15.0%, which indicates a high level of reliability.

Cronbach α is a value that shows the correlation between responses of items. If there is a strong correlation between items, α value will increase. Experts specify that the acceptable minimum value is .70 for Cronbach α, Spearman-Brown and Guttman split-half values [22–25,29]. In this study, Cronbach α and split-half values were found to be higher than .70. A strong and significant relationship was determined between the two halves in the split-half analysis ($p < .050$). If the Cronbach α and split-half values are above .70, and the correlation coefficient is high and positive, this is an indication that the test is internally consistent in measuring the same objectives [22–32]. Also, the results of this study have been found compatible with those of Drake et al [9], Yang et al [10], Rhie et al [15], and Moreno [16]. The current study results show that the scale has good internal consistency for the Turkish population.

High correlation coefficients indicate a strong association of the item with the theoretical construct being measured, and that the item can measure the intended construct effectively. The acceptable coefficient in item selection should be higher than .20 or .25 [22–25]. In the results of the study, all item-total correlations were higher than .25. Results from this study are compatible with those of Drake et al [9], Yang et al [10], Rhie et al [15], and Moreno [16]. The item-total correlation results showed that items have a strong correlation with the total score and have a good reliability level for the PDSS-T.

The regression analysis demonstrates that study variables predict the daytime sleepiness status in a strongly ($R = .60$) significant manner ($p < .001$). These variables explain only 36.2% of the daytime sleepiness status. According to the standardized regression coefficient (β), the order of importance of the independent variables in terms of their impact on daytime sleepiness status is found in Table 3. Significant variables are sleep duration, age, excessive consumption of tea or coffee, eating something before going to sleep, problems of falling sleep, school achievement, use of computer and smoking ($p < .050$) The other variables do not affect the daytime sleepiness status significantly ($p > .050$). The study by Drake et al [9] reported that school achievement, increase of the grade level in the school, age and sleep duration were important factors affecting daytime sleepiness. The relationship detected between these variables and the daytime sleepiness status in this study provided further support for the reliability and validity of the scale. In the literature, eating late, excessive consumption of tea or coffee, sleep duration, sleeping late and excessive use of computers affect the daytime sleepiness status of children and adolescents [3,12–14,33–35]. Relationships detected between these variables and daytime sleepiness in the present study may be accepted as an indicator of high levels of reliability and validity of the scale. The scale might be able to determine the variables affecting the daytime sleepiness status effectively. These results indicate that this scale is a reliable and valid tool for the Turkish population.

Despite the strengths of the study, it has some limitations. First, the researchers did not analyse test-retest results. Also, because there is no reliable and valid Turkish daytime sleepiness scale, the PDSS-T has not been directly compared to other daytime sleepiness related scales. A future research endeavour would be to analyse test-retest results and conduct a convergent analysis with new instruments.

Conclusion

The study's results showed that PDSS-T is a valid and reliable instrument for detecting Turkish-speaking children's and adolescents' daytime sleepiness. PDSS-T is convenient for professionals to prevent and manage the daytime sleepiness. Nurses and other professionals can use the PDSS-T for research and evaluation of daytime sleepiness and its influencing factors. We recommend the use of PDSS-T for carrying out cross-cultural research that evaluate daytime sleepiness.

Conflicts of interest

The authors declare that they have no competing interests.

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